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ABSTRACT

This study is an extension of an on-going longitudinal study, the Girls Engagement With/In Science (GEIS) Project. The GEIS Project was designed to understand how girls who are poor, minority or both, engage in science. The two teachers who form the focus for this study are these girls' 7th and 8th grade teachers. Data for this interpretive inquiry were gathered as field notes, and in structured interviews. The two teachers, taken together, illustrate responsive teaching for minority girls. Although the two teachers are very different in their approach to teaching science, both take every opportunity to provide their students with what they perceive students need in order to be successful. The teaching of one teacher exemplifies the use of subject matter rich content in making science interesting and relevant to the girls. The second teacher in this study provides an illustration of a highly personal teaching style that is effective in establishing the kind of teacher-student relationships that appear to help these girls think of themselves as girls who are good at science. (Contains 27 references.) (Author/YDS)

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Girlsí Engagement With/In Science: Teacher Perspectives.

Patricia A. Lowery and Nancy Brickhouse, University of Delaware.

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Abstract

This study is an extension of an on-going longitudinal study, the Girls Engagement With/In Science (GEIS) Project. The GEIS Project was designed to understand how girls who are poor, minority or both, engage in science. The two teachers who form the focus for this study are these girlsí 7th and 8th grade science teachers. Data for this interpretive inquiry were gathered as field notes, and in structured interviews. The two teachers, taken together, illustrate responsive teaching for minority girls. Although the two teachers are very different in their approach to teaching science, both take every opportunity to provide their students with what they perceive students need in order to be successful. The teaching of one teacher exemplifies the use of subject matter rich content in making science interesting and relevant to the girls. The second teacher in this study provides an illustration of a highly personal teaching style that is effective in establishing the kind of teacher-student relationships that appear to help these girls think of themselves as girls who are good at science.

Introduction

The current science education reform movement (Rutherford & Ahlgren, 1990; AAAS, 1993; NRC, 1996) is committed to equity. According to the National Science Education Standards (NSES), (NRC, 1996, p. 221), "The commitment to science for all implies inclusion of those who traditionally have not received encouragement and opportunity to pursue science-women and girls, students of color, students with disabilities, and students with limited English proficiency." While this is clearly an important aim, it is not clear how teachers are to respond to this call.

There is little doubt that the implementation of reform by teachers is the critical factor in whether the vision will be realized (Atwater, 1994). The NSES (NRC, 1996), provides no guidance on exactly what the equity issues are or how these might be addressed by teachers in the classroom (Rodriguez, 1997). There is a need for educators to see models for what equitable science teaching looks like. The presentation of studies of teachers who are successfully implementing facets of the science education reform vision can provide educators with models of what it may take to teach science successfully to all students.

This study is an extension of an on - going longitudinal study, the Girls Engagement With/ In Science (GEIS) Project. The GEIS Project was designed to understand how girls who are poor, minority, or both, engage in science, both in and out of school, and how this engagement may change through the transition from middle school into high school. The girls in the project consider themselves to be both interested in and successful in science. This view is also supported by one or both of their parents and their teachers.

Observations of the girls in two teachersí grade eight classrooms have raised research questions that form the basis of this study. These questions relate to the teachers and their interactions with the students in their science classes. The questions are: 1. How do teachers define what it means to be successful in science? 2. How do teachers describe their decisions regarding science teaching strategies and how do they justify those choices? 3. How do teachers describe and justify their interactions with their students? These questions were prompted by reflection on the observations of the differences in the two teachersí approaches to science instruction. Despite their very different teaching styles they both had successful science students belonging to groups who, traditionally, might not be expected to succeed in science. This study provides insights from the perspectives of the two teachers to answer the question: What does it take to teach science such that girls belonging to groups who have traditionally been unsuccessful in science can and do succeed?

The Borderlands in the Science Classroom

The well documented problems that face girls in school (AAUW, 1995) and the "glass ceiling" (Spring, 1995, p. 105) that blocks women and minorities in the work place are functions of the complex cultural issues that exist in society, and hence reach into schools and science classrooms. The education system reflects and reproduces the relative power relationships (Foucault, 1984) that exist in society. Our education system is one where in order for some students to succeed, some must fail (McDermott, 1987). This failure is indicated by the results of standardized testing (e.g. NAEP, 1992). Currently those students most likely to fail are those belonging to the least powerful groups in society: minority, poor and female.

One explanation for the relatively poor performance of girls from poor and minority backgrounds is that there is a difference between their lives outside school and the culture in the school classroom. Aikenhead (1998, p. 86) describes how a cultural perspective, "treats the science curriculum....as a cultural artifact and characterizes the typical school classroom as the scene of many cross-cultural events." The borders between cultures and the sub-cultures that exist in studentís lives are described in terms of family, friends, peers, school and science (Costa, 1995; Phelan, Davidson, and Cao, 1991). These clearly show that certain groups of students who have home lives that overlap culturally with school

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lives are most likely to cross the border and achieve success in school science. Those who do not are more likely to become school failures, and be unable to surmount the barriers that exist against the successful participation in science by the "outsiders" to the sub-culture of science education (Brickhouse, 1994, p.401).

According to Driver, Asoko, Leach, Mortimer and Scott (1994, p. 11) "Learning science in the classroom involves children entering a new community of discourse, a new culture." Acknowledging the science classroom as a community with its own set of values, norms, and expectations leads to a view of learning science as an enculturation of students into the culture of the science classroom. The enculturation that learning within the classroom produces may be resisted by some groups of students, particularly if the students perceive the culture of the classroom to be at odds with their own values, influenced by, among others, ethnic, class, and gender identities. An example of resistance is described by Fordham (1996) where urban African American students disengage with school in order to maintain their ethnic identity. This causes problems in terms of the success of African-American high school students in a traditional education setting. (Fordham, 1996):

> For the high achieving students at Capital High, pursuing academic success is a kind of warfare, a calculated conformity intended both to minimize a perception of "lack" and to achieve a higher social status. African-American students who opt to live beyond societyís limited expectations for Black people feel compelled to "pass" by taking on the identity of (an) Other. (p. 235)

The students who fail and refuse to accept the oppression of the "white" school system remain a part of their own culture. This dichotomy, portrayed by Fordham in the expectations and aspirations of minority students, indicates that enculturation, accepting the identity of "Other", is the difference between success and failure. An awareness and respect for cultures within the school system would be one way to reduce this dichotomy for African American students and thus they should not need to be perceived as "acting white" in order to succeed.

The teacher has a prominent role in the facilitation that invites and permits students to cross the cultural borders (Aikenhead, 1998). This requires an awareness of the diversity within the classroom and the ability to provide an environment in which students can safely participate (Guzzetti and Williams, 1996). Teachers are in the best position to remove the traditional barriers of race, gender and social class (Nieto, 1994) to success in school science.

What special teacher qualities does it take to negotiate the removal of those barriers or to facilitate the border crossings? Barton (1998) states that:

> (P)art of my feminist agenda in science education is to create a learning community for students where we can explore ideas about science, ways to be in science, and relationships to have in science that are continuous with and interrogative of our lived experiences. (p. 112)

She refers to "decentering" science by encouraging students to consider the "fuzzy" borders that separate ëschool scienceí from their lived experiences that contain science. This vision of science would help marginalized students to cross the borders of science, to be successful in science. The ability of the teacher to make borders appear "fuzzy" allows students opportunities to understand their own culture and teaches them about the dominant culture. If members of other cultures understand the system and how it works they will be able to cross the borders and have a voice that can be heard in order move toward developing a more equitable system.

A common theme that appears in descriptions of successful teachers of minority students is their sense of care for the students and their connections to the community (Delpit, 1995; Ladson-Billings, 1994). Noblit, Rogers and McCadden (1995 p. 683) propose "caring creates possibilities for learning" and illustrate this from examples of children who responded to the individual caring strategies offered by the teachers. Noddings (1995) suggests that children should be cared for and care for others and that themes of care should be a part of the curriculum.

Ladson-Billings (1994) presents a thoughtful analysis of the teachers (both black and white) who were perceived by the community, and the school administration, to be successful as teachers of minority students. She shows how a range of individual styles can result in what she defines as "culturally relevant teaching". The teachers had high expectations for all of their students and use what the students already know as a basis to extend learning. The teachers use every opportunity to expand their studentsí knowledge within a context that has meaning for the students, a skill that requires substantive subject matter knowledge. The teachers were also part of the community and knew their students well.

A similar story of successful teaching for minority students is shared by Delpit (1995) who suggests that:

> (A)ppropriate education for poor children and children of color can only be devised in consultation with adults who share their culture. Black parents, teachers of color, and members of poor communities must be allowed to participate fully in the discussion of what kind of instruction is in their childrenís best interest. Good liberal intentions are not enough. (p. 45)

In order to facilitate the studentsí "border crossing" between home and school environments, the teacher needs to

have a clear understanding of what both sides of the border are like. Delpit (1995) shows why teachers need a deeper understanding of the significance and meanings of multiple aspects of their studentís culture. Only with that understanding can a teacher help students to negotiate the borders, to make them "fuzzy" so that students see from both perspectives, their own and the "standard classroom" and can interpret the relative meanings. Delpit showed how a teacher, sensitive to the needs of the students does not devalue their local language but at the same time allows them to learn to communicate in "standard English" (p. 103). The explicit presentation of expectations by the teacher helps students negotiate border crossings. In white middle class society many requests do not sound like explicit demands, and thus, easily lead to misunderstandings between teacher and students from other cultures.

Border crossing can only successfully occur when all parties are aware both that the borders exist and what life is like on either side. Teachers need to understand the communities that their students come from. Through a caring and informed approach, teachers can help students understand that they are part of a multicultural society where border crossings are possible for all.

Description of Data

The data needed to support this extension study of the GEIS Project were gathered through field notes of classroom observations; informal interviews with teachers; audio-recorded, structured interviews with students, and parents; audio-recorded focus group meetings with students; and through audio-recorded, structured interviews with the two participating teachers.

The School and the Teachers

The large middle school has students in grades seven and eight. It has a diverse population of students that is comprised of 41% minority students, most of whom are African American. Students attending the school represent a mix of socio-economic status with 15% of students qualifying for free or reduced cost lunch programs. The girls in the GEIS Project are assigned to the eighth grade science classes of two female teachers. Mrs. Dawson is an African American with seven years experience as a science educator, and Ms. Taylor is European American with two years teaching experience. The principal describes both Ms. Taylor and Mrs. Dawson as "excellent teachers."

The teachers are grouped in the school by "Teams" so that each team teaches the same group of students and may jointly plan activities for their students. Students will often have the same teachers for 7th and 8th grade since many of the 7th grade teachers move to the 8th grade with their students.

Classroom Observations

The classrooms of the two teachers were observed weekly from February through May 1998. In addition, Mrs. Dawson was observed bi-weekly from February through May 1997. Notes were taken and artifacts were collected during the visits or field notes were written immediately after each visit.

Teacher Interviews

The teachers consented to participate in this extension study and were interviewed using the protocol described in Appendix I. These interviews were audio-recorded and later transcribed. The transcription of the audio tapes produced from the teacher interviews were read for analysis. Copies of the transcriptions were given to the teachers for comment and feedback. Both teachers indicated that the transcriptions conveyed an accurate representation of their answers to the interview questions.

Analyses of the Data

The analyses of data from the GEIS Project formed a qualitative, interpretive inquiry that is both ongoing and recursive (Erickson, 1986). The analyses of teacher / researcher dialogues, together with classroom observation data and field note records were used to develop narrative profiles of the teachers. The teachersí perspectives of science, science teaching, and interactions with their students examined in this study will contribute to a developing understanding of the opportunities that students in their classrooms have to engage with / in science.

Mrs. Dawson

Mrs. Dawson is an African American and an experienced science educator. The girls in the study and the parents who were interviewed consider Mrs. Dawson to be a good science teacher. She has a strong science content background and is comfortable teaching the students in her eighth grade class, many of whom she also taught seventh grade science.

Mrs. Dawson spoke very candidly with us about her own experiences of racism both as a child and as an adult. Her light complexion provides her with access to uncensored racist remarks from white people who do not recognize her as African American. Thus, she knows that racism is a factor in her own and her studentsí lives. As a child, she was

called a "nigger lover" by white students for hanging out with African Americans (whom they did not recognize as her siblings). When she changed to an all-black school, she was assaulted and called a "cracker." As a result, she is extremely cognizant of the importance of being compassionate to her students and making sure that students are not allowed to treat one another disrespectfully.

Her large classroom contains only lab stations where students sit in seats randomly assigned by the teacher. She has the students move to sit in a circle around the central teacher table for class discussions. The walls of the classroom support a number of posters, several of which were produced by NASA which include pictures of scientists of diverse ethnicities and others with inspirational messages like "your attitude determines your altitude." A changing display of student work usually covers at least one of the walls.

Three different researchers observed Mrs. Dawson and all had similar reactions to visiting her class. She was unique. Research team meeting reports from her classroom usually started with "You wonít believe what happened in Mrs. Dawsonís class yesterday."

What does it mean to be successful in science?

Mrs. Dawson believes that there is more to life than academics. Being successful depends on the development of attitudes and skills necessary to fully participate as a member of a diverse society. To her, a successful student is one who works hard, is confident in his or her abilities, and above all is prepared to take risks.

Mrs. Dawson equates success with survival in society. According to her the essential element:

> (F)or a person to survive and be successful in life is not necessarily the academics but those socialization skills, interacting with as many different personalities as you possibly can and having to cope and deal with those. You know when you get out [of school] you see those faces and the personalities again. The names and the faces change but you see them and you need all those years of working and trying and doing. (Interview, 6/1/97)

Her perception of what it means to be successful has been shaped by her own life experiences. For her students, she is clear about what it takes to be successful in science in school:

> You have to be comfortable with yourself, because science requires taking risks and not knowing the answer, umm, and not being afraid of getting things wrong.Ö If it doesnít blow them away if something is incorrect and even if they are not really sure about what they are doing but they are willing to try any way. (Interview, 5/22/98)

Mrs. Dawson sees her studentís attitudes toward schoolwork and the effort that they put into the activity as more important indicators of success than just getting the right answer.

Mrs. Dawson describes what a "successful science student" might look like:

> My success story would not necessarily be the honor roll student. I love the honor roll student but if they could leave my classroom with a strong sense of self and secure in success, and secure in failure, and understanding that they have to put forth effortÖ And not being afraid to raise their hand next year in their classes and say "hey - Iíve got an opinion that counts" and not being afraid to screw up, you know, in the lab and to learn from it and then try it again and do it better. (Interview, 5/22/98)

A number of lab activities were carried out in Mrs. Dawsonís class where a single letter grade was awarded to the whole group of four or five students. She explained that the real value from her perspective for group work was the development of skills that would be of future value to the students:

> For middle school students, if by chance they get through a lab and they havenít horsed around and they gather some data and they work within reason, then to me thatís an A. Because they need that experience and that I am reinforcing again, is the process. Not did they have all the measurements down to the Nth degree, it takes time and it takes practice. (Interview, 5/22/98)

The process of the group working together would produce a higher grade than the individual data that the group collected or analyzed. The content is of secondary importance to the process of cooperative group work.

The value that Mrs. Dawson placed on the skills needed for both science and life was a recurring theme. Although the content or factual information was not as high a priority as might as might be expected in some lessons, others contained large amounts of factual, scientific information. For example the teacher introduced the weather unit by showing a National Geographic video and instructed the students to take all the notes they could on preparation for a "pop quiz" the following day. She told the students to "Rewrite the notes tonight, why?" The studentsí responses indicated that they understood that this was a way to help them to memorize the information that they needed to

know to be successful in the quiz. Students were encouraged to call their classmates during the evening to compare notes and make sure that they had recorded all of the facts contained in the video. She related this to the type of behavior that would be expected from the students in high school and in college. She suggested that they would have a problem if they didnít "learn how to suck up to your classmates." (Field notes 3/10/98). Strategies that would help the students to succeed in high school were pointed out whenever possible.

Success in science for Mrs. Dawsonís students, was not directly connected to the studentsí understanding of the science content as defined by curriculum and standards documents such as the NSES (NRC, 1996). For Mrs. Dawson science content was facts that could be memorized for quizzes or tests. She placed a much larger emphasis on the explicitly presented dispositions and skills that she felt her students would need to develop in order to be successful both in school, and out.

Decisions regarding successful science teaching strategies.

Mrs. Dawson focused explicitly on the need for students to develop skills that would benefit them, not just in science class but on into high school and throughout life. During class she modeled and supported the desired skills and behaviors with lesson content that was taken from current news events or from issues related to the studentís lives. Many of the strategies can be illustrated in a weather unit that required students to collect data from the daily newspaper and combine their developing understanding of weather with research about a specific city in order to present a report to the class.

Many of the skills that Mrs. Dawson aimed to develop in her students had been necessary to her for her own success in life. For example, her public speaking skills helped her win a high school Beauty Pageant that provided scholarship money to support her through college. On occasions, the students would be asked to practice public speaking skills. In preparation for presenting their weather reports to the class students were asked to individually stand and say, "It is a glorious day" with "a smile and a straight back". Mrs. Dawson offered extra credit if they "dressed up nice or wore a tie" (Field notes, 4/1/98).

Mrs. Dawson models what is required and shares examples of a range of materials produced by students in previous classes. An example of how she scaffolds the class through an unfamiliar activity occurred during the research and development of weather reports by individual students. One part of the report required the plotting of weather data for a selected city over the period of a month. Mrs. Dawson had all the students spend class time practicing the task. She scaffolds the activity by going step by step through the data, explaining the process of average temperature and detailing how to set axes and make bar plots. During her interview she said that she "models" her expectations and states her marking criteria at the beginning of the exercise in order to "remove all of the mystery" (5/22/98). Mrs. Dawson leaves her students in no doubt as to what her expectations are of them and the task that she has set them.

When asked if the school curriculum constrained what she taught she described herself as "just a devious teacher", able to make use of teaching opportunities and topical events as they arose:

> If something comes up, like the septuplets wasnít a thing on the list this yearÖ. ëLess is moreí, and I find that you donít have to do as much, to go into depth and you can take one topic and use it to meet many objectives. You know if you want them to learn how to measure, you can do measurement with pretty much every discipline in science so you have leeway. But I never stick strictly to the curriculum. And in science you really canít because there is so much going on that you need to take note of as it happensÖ. Sometimes the kids bring stuff in and we just have to drop what we are doing because, you know, itís that interesting to them. (Interview, 5/22/98)

During the same interview, Mrs. Dawson stated that she considered one of her teaching strengths to be the ability to make the abstract curriculum material seem real to the students. An example of this was when she had them write a creative news story around the effect of a(n) (imaginary) tornado hitting their school. Certain elements must be included in the story, such as wind speeds and the category of the tornado. Mrs. Dawson stated many of the student stories were "hilarious." The strategy here was intended to introduce "a little spice" into the curriculum and at the same time permit the assessment of her studentsí science content knowledge.

Mrs. Dawson used quizzes and tests to count toward grades. On these assignments all students were treated the same. For written projects, however, she took into account her assessment of individual ability. Students she considered to be of higher ability were held to a higher standard than others. Not all teachers in the building agreed with this:

> And thatís hard for some people because they go "Well you should grade everyone the same, you should, you know," but I donít expect someone who reads at the second grade level to turn in an essay like someone who is reading at the college level and I expect that and I take that into consideration. (Interview, 5/22/98)

Grades were considered important by both Mrs. Dawson and the students and celebrations were held for students who got an "A" for the marking period or got on to the Honor Roll among other things. Occasionally, she used grades as a means of making a larger point. For example on one occasion she reinforced the need to meet all the criteria of

an assignment by announcing that the grading the assignment would be "A" or "F." They could not get a passing grade on the assignment unless they met all of the criteria. She justified this "hardball" strategy as follows:

> The biggest thing that I have noticed with my kids here at the middle school level is their lack of attention to detail, and their inexperience with meeting requirements as set as opposed to doing things to just get it over with and get a grade. And, I really stuck it to them with the weather project. I made it all or nothing, and I gave up class time so that if they understood that I meant what I said. That they would follow along and if they didnít they would have an F, and there were many tears and there were many parental phone calls and there were parental visits. Because the projects were A or F but I stuck to it. Now I didnít count the project as a huge portion of their grades so it really didnít have the impact that they thought it did. But they donít need to know that. (Interview, 5/22/98)

Most middle school students take their letter grade seriously and the teacher perceived this strategy as a way to make them focus on matching their product to the criteria set for the assignment. This was important to her as a way to prepare the students for high school. The students in Mrs. Dawsonís classroom were held to standards she determined were compatible with their ability level. However, in order to encourage an improvement in the quality of student work she was at times uncompromising in her standards.

Mrs. Dawson constructed a curriculum she believed was best for her students regardless of other teachersí opinions. Ladson-Billings (1994, p.127-130) described this as a "subversive pedagogy". However, Mrs. Dawson was primarily focused on the particular students in her classroom and not the larger political picture of forcing a change in the whole school system. Mrs. Dawson would fit the description of what Ladson-Billings described as a culturally relevant teacher in that she expects all students to succeed (p. 44), is prepared to take individual student differences into account (p. 98), explicitly teaches skills and scaffolds students in the development of the needed skills (p. 96), and is a part of the community with the families of her students (p. 62). A difference between Mrs. Dawson and the teachers Ladson-Billings described related to their view of the lesson content. Ladson-Billings presented culturally relevant teachers as "passionate" (p. 81) about the content of their lessons, where students are active participants in the knowledge building process. For Mrs. Dawson it was evident that the passion in her teaching strategies related to the need to help students with the development of skills that would be of use later in their lives rather than encouraging students as active participants in the knowledge building process. Mrs. Dawson uses direct teaching with very explicit presentation of the required content knowledge.

Interactions with students

Mrs. Dawson knows her students well and lets her students get to know her. She is prepared to, and does, address racism directly. She uses humor throughout her teaching and pays attention to the emotional needs of her students.

Mrs. Dawson described her interactions with her students related to her own experiences: "I believe in being personal with the kids because I treasure my personal relationships that I had with my teachers." (Interview, 6/1/97). At the beginning of the school year Mrs. Dawson tries to get to know her students:

> What I do the first two weeks of school is really a quick, hurry up, get to know. Get to evaluate, I test for reading levels, I survey for personal interests and background knowledge in science and just really check what home life is about and all that. Then I sit down and I analyze and think what have I really got here. (Interview, 5/22/98)

She expressed sadness that classes for the year are nearly over, stating that, "I woke up crying this morning because we are only having two more weeks. Two more weeks and my babies will be gone for high school and itís hard because I have had them for two years" (Interview, 5/22/98). Mrs. Dawson had worked with each of her classes to generate a "class" spirit. An example of how this was developed was seen during an observation the day Mrs. Dawson returned after a substitute teacher had taught her classes. The substitute teacher had reported an incident of a student "flicking water" (field notes 2/24/98). When challenged by Mrs. Dawson about the incident the student asserted that he had just been washing his hands because his pen had leaked. Mrs. Dawson asked the class if they would corroborate the story and several students agreed that there had not been a problem. She said she felt there must have been a misinterpretation of what happened and that as they all agreed there was no need for her to take further action. Mrs. Dawson told the class that she wanted them to see themselves as a group and know that they could rely on one another.

Mrs. Dawson frequently shared stories from her own childhood, living on a farm, as a way to let them get to know her, and as a way to make a point about science. On one occasion (Field notes, 3/20/97) during a lesson on the flow of matter through a biological system she illustrated how people as consumers fit into this cycle with a vivid story of how they slaughtered and processed pigs on the farm. The class sat enthralled as Mrs. Dawson described how one particular pig had appeared to be "possessed" as it survived being shot between itís eyes, having itís throat slit and being plunged into boiling water only to climb out of the boiling water. In a story filled with expressive details she described how this particular pig survives through two more complete cycles of the killing process. Once it finally dies she explained how every part of the pig was used, using graphic detail that captivated the class of urban and

suburban middle schoolers who had no idea of how pig skin was fried or how intestines became chitlins. The story was told without any interruptions. The class was asked to make connections between the producers, consumers, and decomposer, in her story.

She is willing to share that teachers, like everyone else, are human, and shared with the class how she had got an "F" for a report because she didnít follow the requirements. She used the detailed story of her own High School experience as she explained to illustrate that no one is perfect. "A well rounded, realistic view I think is the best thing, because if youíre perfect in every way then what happens to the children who arenít?" (Interview, 5/22/98.) Mrs. Dawson believed that both success and failure should be a visible and acceptable part of the student experience.

Mrs. Dawson offered a pizza party reward to whichever of her classes had all students in the class achieve a grade of "B" or better for the marking period. At the end of one marking period she: "Had bags of microwave popcorn for any student who got an "A" and rolls of "smarties" for any one who improved in any subject during the marking period. Everyone got a lollipop (including me)." (Field notes, 2/17/98)

Food rewards and opportunities to buy slices of pizza with other items provided by Mrs. Dawson were appreciated by the students. Any student making honor roll was treated to a visit to the local Dairy Queen. If students were unable to pay their contribution to the cost she would pay for their food herself. She did not want any student excluded. She always made sure that all students had access to the same opportunities. Mrs. Dawson always announced that project materials that students may need were available in her office.

Mrs. Dawson knew many of the students and their families from the local community. If a student behaved badly she would have the student call the parent immediately from the classroom. If the parent was not available they left a message. She knows the students in her classroom:

> I think it is extremely important to know who these children belong to. What their home life is like umm, how they interact at home - tells a lot how they will interact with you by way of their interaction with their parents. (Interview, 5/22/98)

Her classroom connects to the home life of the students and extends to the parents.

The girls in the GEIS Project were invited to a "sleep over" at Mrs. Dawsonís house as an end-of-year treat. It was not unusual for her to have a small group of girls request that they be invited over. She used these opportunities to better get to know the students and to build on their classroom relationship. Developing a personal relationship with the students was an important part of the teacherís strategy.

Mrs. Dawson was very insightful about the challenges faced by her female, minority students as they prepare to leave her grade eight classroom. Her own experiences had made her especially aware of what it is like to grow up facing those same challenges:

> The biggest challenge that they will have is the people who are not very direct. Will indirectly bias, and they will never know hindered or did not put forth an effort to help them. But time will only tell how determined they are. Because determination will overcome all of that, any obstacle. And I have seen that over and over again.
>
> I: Do you think that the obstacles are any less than they were at the time when you were at college level?
>
> D: I think that now people have a more watchful eye in some sense. I think it is always going to exist. Itís just the way society is. Itís like in terms of how we deal with the gender equity issue. I donít see a time in our life time when women will be paid on the same scale as men. And I donít think that the sexual promiscuity will be handled the same way you know. Men will still be "good old boys" and women will be you know, wayward souls. When it comes to it. I think some of those things are pretty much etched in stone for a long time. And I think those are real things that they have to deal with and I think people should tell them, continuously that they exist and they make life more challenging and more difficult but that is the way it is. Get over it and work through it!
>
> I: So be explicit. Know it exists.
>
> D: Yeah. Do not sugar coat the world or withhold information. I get very angry with parents who let the world teach their children lessons. As opposed to teaching them lessons. I think that is the greatest disservice that you can do to any person, child or adult, youíre just setting them up for great disappointment and perhaps a hurt or a pain that they canít recover from because we are not all at the same level of resilience. And so itís a big thing. (Interview, 5/22/98)

Mrs. Dawson is very aware of societal biases in terms of racism and sexism and appears to accept that they are a part of society that is unlikely to change. As Mrs. Dawson explained in terms of racism "I get to see both worlds"

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(Interview, 6/2/97) because in casual conversations with other people who are unaware of her ethnic background she hears "their philosophy, and it can be racially derogative"óa philosophy that they would never have shared had they known her to be an African American. She is acutely aware that what people say may not reflect their true beliefs. She wants students to know that these biases exist. To be told explicitly what to expect so that they are prepared to deal with them. A lot of that responsibility she places in the hands of parents. As a teacher she feels the need to be equally explicit with her students.

During February, Black History Month, Mrs. Dawson gave her students a graded exercise to find famous African Americans from A to Z. To name them using either a first or last name to fill a space from A to Z. Several class periods were spent watching the first videotape of the television series "Roots". The classes discussed the history of African Americans related to what they had seen on the video. She explained that she showed this because "Some of their parents have moved on past this and donít want their kids to know." (Field notes, 3/3/98)

She told the class that this was the only TV show that she was ever allowed to stay up past her bedtime to watch when she was their age. She shared how important this was to her to understand what had happened historically. Later, during a particularly poignant section of the movie several of the girls were in tears. The teacher nipped any comments by saying "Itís OK to cry" (Field notes, 3/3/98). Emotion is acceptable in this class room. It is a safe environment for the students to discuss emotional events. The spate of school shootings in spring 1998 prompted the teacher to pose the question for students to write a reply to: "If we are the most complex and intelligent life on earth, why is it that we are so violent?" (Field notes, 4/28/98). This followed their viewing of the movie, Life on Earth, as part of her lesson on the classification of organisms. The connection of curriculum, topical events and emotional content was intended to keep the student interest. Topics that might be considered "difficult" to discuss were openly addressed in this class room.

Humor is an integral part of Mrs. Dawsonís lessons. To give an example, Mrs. Dawson used humor in one lesson to cajole student cooperation through a tedious task. She did this with the activity during the weather unit where she scaffolded the students to construct bar charts using weather data. The students completed the task within an atmosphere of humor as Mrs. Dawson referred to the "cheap crayons" they used to color in the bars of the chart. She made a joke of the fact that the crayons were poor quality. Despite being on her "Christmas wish list" (field notes, 3/24/98) she hadnít gotten any better ones. The students did not complain as many 8th grade students might have about using crayons for the task. Mrs. Dawsonís expectation was that they would all complete the task and used humor to keep everyone working toward the completion of the lesson objective.

In summary, Mrs. Dawson displays a highly personal style of teaching that connects to the students and to their lives. The science content is not the primary focus of her teaching and at times appears to be marginalized. She develops a close relationship with her students and emphasizes the development of study skills and attitudes that will benefit them in later life. Her grading of student written materials reflects her understanding of each individual studentís reading and writing ability and effort. A number of the strategies that Mrs. Dawson uses within the classroom, in particular the scaffolding of skills, consideration of student abilities and the strong sense that she is aware of what students need from her classroom to be successful, overlap with those described as constituents of culturally relevant teaching that are illustrated through examples by Ladson-Billings (1994). Mrs. Dawson is aware of the biases in society and she has a deep, personal understanding of the impact of racism on her students.

She is extremely supportive of her students and knows most of them and their families personally through the community and through a deliberate process of making contact from the beginning of the school year. She reinforces her position of authority by aligning herself with the parents of the students. Mrs. Dawsonís strong community links, personal style of teaching and making of her expectations of the students explicitly known fits with the descriptions of successful teachers of minority students presented by Delpit (1995). Mrs. Dawson interacted with her students much as the teachers described by Delpit (1995, p.140) where the strongest relationship was between the student and the teacher and where content was only one aspect of that relationship. According to Delpit (1995, p.140): "Teachers who view creating relationships between themselves and their students as central to the teaching task may be misjudged by assessors expecting to evaluate their knowledge of and involvement with content." This may well have been the case for Mrs. Dawson if an assessor had walked into her classroom and observed her.

This same message of making expectations explicit is illustrated by individual teachers who have worked successfully with students who might not traditionally be expected to succeed in the current educational system. Teachers such as Mr. Escalante, who was portrayed in the movie "Stand and Deliver" (Musca & Menendez, 1988) based on the real life experiences of teaching advanced mathematics to Latino students in Los Angeles, and teachers described by Ladson-Billings (1994) and Delpit (1995) who successfully taught minority students should be examined carefully as they contain significant insights into teaching strategies that benefit all students and not just those from the dominant culture.

Ms. Taylor

Ms. Taylor is a young, white female who is just completing her first year teaching eighth grade science in this middle school. Her strong science content background is supported by degrees in the biological sciences and in secondary

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science education.

In her classroom, students frequently work in individual seats set in orderly rows or stand and work as pairs or small groups around lab stations. The huge space available in the classroom allows flexibility in terms of student working arrangements. Occasionally, when researching or presenting materials the orderly rows are broken as students pull seats together to work in pairs or small groups. Students are allowed to select partners when working on their projects. Posters relevant to the instruction cover the walls. A bulletin board displays cuttings of recent newspaper reports showing "Science in the News".

As a relatively new teacher who graduated from the local university she is familiar with the state science standards that closely parallel the National Science Education Standards (NRC, 1996). She is planning to attend professional development during the summer in order to be better prepared to teach to the expectations of the new national and state standards.

What does it mean to be successful in science?

In order to succeed at science Ms. Taylor felt that students needed to be held accountable and to work hard. Ms. Taylor believed that it was helpful to have an innate interest in or appreciation of whatever was being studied. She also wanted her students to begin to develop the higher order thinking skills that they would need later in order to be successful.

For Ms. Taylor students with a natural interest, who are focused, devoted and accountable, are, in her view, most likely to succeed academically in science. She wanted to express the academic emphasis that appears to her, to be inherent to school science. She believed that a general understanding of science was a necessary part of life

> One of the things that could help you is to have an innate desire towards science or just a natural interest... you need to be a devoted, focused, dedicated student ....And you need to be accountable to succeed in science academically. To be good in science over all...you need to have an appreciation or understanding for living things, the earth, how it works, physically and biologically. (Interview, 5/20/98)

To be successful at science even at a general level students need to be able to make connections between what they did in school and science as it appears in daily life in order to understand how living things or the earth work. Ms. Taylor used materials in her classes that guided students to connect what they were studying with the bigger picture of what that meant to their everyday life. This was the case during a unit on infectious diseases where students learned about the various infectious agents such as bacteria and viruses. They then found connections with newspaper and magazine articles that discussed among other things the value (or not) of toilet seat covers as protection from infection and how new forms of influenza develop.

Ms. Taylor stated grades were not a perfect measure of success in school science. She acknowledges that studentsí grades are to an extent determined by how well they remember information related to vocabulary words, definitions and formulae that would not be of value in real life -- the subject matter for quizzes and tests that form a part of her instruction. According to Ms. Taylor: "I would say that understanding, grasping concepts, being able to think critically, being able to problem solve, that is success in science."

Ms. Taylor defined the year long objective of her science lessons not in terms of the more academic parameters but in terms of the value she places on the development of the higher order thinking skills as a route to success. The skills she wants to see her students begin to develop:

> Being able to take a general concept to a deeper level. To be able to problem solve and think critically. They are at the age now in seventh and eighth grade where they just learn, they are just staring to learn how to think hypothetically.Ö What I want to do is give them the basics and the building blocks. Proper basics, proper building blocks so that they can develop their ability to think hypothetically. (Interview, 5/20/98)

Ms. Taylor encouraged her students to think "hypothetically" by asking them to think about connections between the factual content and social issues related to the content and to understand that many situations involve both benefits and risks. An example of this occurred during her unit on genetics. The students had learned about the genetic code and were also exploring the effects of inherited genetic defects. The class watched the movie, Jurassic Park (Kennedy & Molen,1993) and were asked to write an answer to the problem "Should people try to recreate extinct species?" (Field notes, 3/3/98) The assignment required the inclusion of at least six potential benefits and six potential dangers resulting from the development of this technology.

Ms. Taylor supplies structure and resources to help her students reach her objectives. The teaching units that she develops provide the building blocks that guide the students to make connections between the factual content and appreciation of the application of that content in a larger context.

Decisions regarding successful, science teaching strategies.

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Ms. Taylor developed instructional units that included current issues in the news and items that were relevant to students and their lives. She provided extra time and support to help her students maintain academic standards and she incorporated strategies that held students accountable for their work.

In the spirit of the reform effort for science education, "Inquiry into authentic questions generated from student experiences is the central strategy for teaching science" (NRC, 1996, p.31). Ms. Taylor develops this strategy for a unit on infectious diseases that asks the students to consider "diseases/ illnesses/ sicknesses that are common today" (Field notes 3/17/98). An assignment asks students to find what causes each disease, signs and symptoms of the disease and how the disease might be contagious. After considering common diseases that they are familiar with the students read a book about the life of Ryan White, a young boy who becomes infected with HIV and later develops AIDS. Asked why she chose to have the students read this autobiography she said:

> I did it more like for a hook. You know, to hook them, to grab their interest. Why not yank their emotional chain and see if that is going to grab their attention. I do anything to grab their attention, to keep them focused, try and get them interested. And a lot of the kids know people who have had AIDS, so I have tried to relate it and make it practical, make it real for them. (Interview 5/20/98)

Ms. Taylor attempts to understand her studentsí interests and designs her curriculum materials in consideration for them. She wants them to connect what they learn about in class to their lives:

> I wanted to connect society with science, and that is the main reason why I had them read Ryan White. I wanted them to think of social issues and connect them with some scientific facts, scientific information. To make it real for themÖ. That is just my experience, the more that it means to them the more they will appreciate it. The more they appreciate it the longer it will stay with them and they can carry it on in their life. (Interview, 5/20/98)

The students read the book in sections, mainly for homework. It also counted toward their book reading assignment for English as the team of teachers had planned this together. The insights from the book were discussed as a class. This connected to other classroom activities such as completing a "virus in a bag model" (Field notes, 3/24/98), where students assembled a model of a virus using craft materials to represent the essential components of a virus inside a plastic bag.

This connection of science content material to other disciplines was not an isolated example. When discussing inherited genetic disorders and a homework assignment on Huntingtonís Syndrome, the students were reminded to consider the social implications of the availability of tests to detect this disease as they would be considering those in their social studies lesson. (Field notes, 3/10/98). The teacher works within her teaching team to integrate materials across subjects. This type of collective planning is described in the National Science Education Standards as a cornerstone of science teaching:

> It is a vehicle for professional support and growth. In the vision of science education described in the *Standards* , many planning decisions are made by groups of teachers at grade and building levels to construct coherent and articulated programs within and across grades. (NRC, 1996, p. 32)

Ms. Taylor appears to share the reform effort vision of what constitutes good teaching.

Ms. Taylor facilitates studentsí work by making clear her expectations and structuring the work into smaller sections. Examples of "good" products shared with the class clearly illustrate what is expected and good behaviors such as politely asking questions of the presenter are modeled to concretely reinforce her expectations. An example of this is the class research project assigned for "Black History Month". The class was discussing the role of minority and female scientists in preparation for a weeklong project of research into a selected individual. The teacher introduced the lesson with a cartoon from the newspaper to start a discussion on the stereotypical view of a scientist -- as male and white. Students were directed to sign up with a partner to research an individual minority scientist that was listed on a teacher-produced hand out. Minority in this context appeared to be defined as either African American and/or female. Students were also allowed to come up with their own suggestions.

The hand out also specified the expectations and the grading system for this exercise as a means to scaffold the activity. Ms. Taylor shared an example of a presentation from a previous year. She facilitated the students in their research by making sure that materials such as reference books and Internet access were available in class and that the school librarian was available to help students access any other resources that they needed. Ms. Taylor was aware that not all students had access to the resources needed to complete the task outside of the school building. Ms. Taylor also made herself available regularly after school to help students complete work or prepare for an up coming test.

Ms. Taylor wants students to be accountable for their own grades. It is up to the students to take advantage of the extra opportunities that she provides outside of class, for example, to catch up on missed work or prepare for tests. Grades provide a measure of individual studentís achievement. This individual accountability was also present in

group work exercises in the classroom. She considered labs to be a good place for group work:

> I like it for labs. I think it is important. It helps with comprehension. It fills in the gaps where maybe one person is weak, the other person can take over so I like that. When we do seat work whether they are doing research or an activity or even a work sheet and I let them do it in groups thatís when I get really leery because that when I feel that they are not doing equal amounts of work. One person will take advantage of the group aspect and they will use it to socialize rather than stay focused and do the workÖ. What Iíll usually do is Iíll let them turn in the paper together or Iíll have them turn in the product as a group and then other times I make them each turn in their own to force them to do their own work. So that they will stay focused and basically theyíll earn the grade that they get. Iíll feel more comfortable about that. (Interview, 5/20/98)

Students needed to earn the grades that they got, to focus and work for their individual success.

Ms. Taylorís general science curriculum is supported by her own content knowledge. She sees her strong content background in biology as well as the other sciences to be important to her teaching:

> One of the things is to have that content knowledge, that background knowledge at least in biology. Because biology is a very general degree. You have a little bit of chemistry, you have a little bit of physics so itís an advantage to have biology because you have those other core subjects in science that at least you can touch upon and for teaching seventh grade it is definitely a benefit to have thatÖ. If I had my choice I would teach specifically biology because that is my strong point, that is my natural love. That is my preference out of all the sciences. But I canítÖ I need to put in a little bit of earth and put in a little bit of physical. (Interview, 5/20/98)

Her content knowledge is important because she does not rely entirely on textbooks and continues to plan integrated lessons that will "hook" her studentís interest and connect to their lives.

Ms. Taylor presented content in line with the expectations of the current reform effort (NRC, 1996), she designed the content to help her students relate to the material and see itís relevance to their lives.

Interactions with students.

Ms. Taylor understood the challenges facing middle school students well enough to know what motivated them and was able to capture their interest in her curriculum. She knew her students better than they knew her.

Ms. Taylor has an understanding of the peer relationships between eighth graders. When discussing one of her female students she explains how this student is exceptional in her relationships with other students:

> Tanisha pals around with a lot of males where as at this age, you pal around and you are friends with and buddies with the same sex. And you joke around with and tease and date the opposite sex. Where Tanisha does it both equally with both sexes, which is you know, she can hold her own in or with a group of guys or she can hold her own with a group of girls. (Interview, 5/20/98)

She is concerned that students maintain as high a grade as possible and together with offering extra work opportunities outside of class time she also talks to students and contacts parents when a studentís grade declines. The student grade provides a tracking system that indicates developing student problems. Some students like Sheela do not require the teacher to make parental contacts:

> I think at the very beginning of the year, before I even knew about this program I called her parents to say that sheís doing really well and have not spoken to them since then because all the other students consume so much of my phone time....Sheís basically an A student. If you were to grade her on ability I would say sheís around a B but what she does is that sheís focused and sheís motivated and she is intrinsically motivated so she wants to do well, so she succeeds... (Interview, 5/20/98)

The definition of extrinsic versus intrinsic motivation arises several times during the teacher interview and is an important concept used to describe her students and their ability at science. When asked about Sandy and her performance in science the teacher made clear her reference to the source of student motivation:

> Sheís much more conscientious because of the fact that her parents are on her so much she knows she has to. She knows she has no choice and we sign her agenda book every day that has her homework and assignments in it. And again sheís, right now, because of her age, fifty percent of her, sheís intrinsically motivated the other percent sheís motivated externally from her parents. (Interview, 5/20/98)

In this example the teacher and the parents work together to ensure the success of the student as measured by her grades. The teacher wanted students to hold themselves accountable and reminded them in class of the need to be

personally responsible. In some cases the teacher worked together with the parents to ensure that the student remained focused on the class work.

Ms. Taylor was very willing to take feed back from students in order to improve her classroom practice. During the genetics unit the students were watching the popular movie "Jurassic Park" as Ms. Taylor walked along the rows checking that the homework assignment had been completed. She took the opportunity to tell the researcher that this particular movie was a great vehicle for the current science topic. She also explained that earlier in the year she would have just shown "the relevant section" (Field notes 3/10/98) of the movie prior to a class discussion. However, when she conducted a survey (likes, dislikes and places for change) of her classes half way through the year the overwhelming response to what she should change was to "show the whole movie and not just bits." The studentís suggestions were taken seriously and acted on. Ms. Taylor was concerned both to meet the needs of her students and to respond to their requests in order to improve the classroom practice for their benefit. As a young teacher she was both able, and prepared, to listen to her eighth graders. When asked if she felt that her own race and gender had any impact in her relationship with her students, in particular with the three African American girls in her class who are part of the GEIS Program, she responded in terms of race.

> T: Sheela, No. With Sandy, no not really. With Tanisha. Yes. I think that you know. Tanisha is just, is one of those people that just, I guess you would stigmatize as someone with a bad attitude. You know she is not motivated, has a bad attitude.
>
> I: ... Is it just with you, or is she the same with any adult?
>
> T: With any adult. I mean I think she has internalized a lot of the black, white, race issues from the past. It could just be from her personal experience. It could be from her familyís experience and what has been taught to her or what has rubbed off. I donít know but I do think that thereís yeah, a little bit of animosity between, you know, about how she feels towards white people yes. (Interview, 5/20/98)

On a form Tanisha described herself as African American/mixed. We observed her group of friends to be exclusively African American. At times she was eager to show her knowledge and respond to questions from her teacher. If she was not called on to respond she shouted out the answer and was occasionally disruptive. In many respects she exhibited behaviors of African American girls described in Fordhamís work (1997). To thwart this potential behavior problem it appeared that if Tanisha raised her hand she was almost always called upon first and she was rarely challenged for sitting in a seat to which she was not assigned. On other occasions she was sullen or moody or unwilling to participate. On these occasions she was usually left uninterrupted. By accepting Tanishaís attitude and facilitating her behavior she was providing her student with an opportunity to succeed academically in her class rather than sending Tanisha from the room and to an administrator that might suspend her from school. Ms. Taylor, it appeared, did not want to provoke Tanisha into behavior that was unacceptable in the class and interpreted Tanishaís attitude at least in part as due to their different races.

The students always worked in single sex groups in this classroom or sat at individual seats so gender interactions were not visible to an external observer. Ms. Taylor, when asked to predict any future challenges that the same three students might face due to their gender, responded:

> T: Tanisha - no, because she has a strong personality and she is a very confident, strong, individual.
>
> I: Uhhuh
>
> T: Dynamic in that sense. I donít, she in no way is intimidated by any person, let alone by the opposite sex.
>
> I: OK
>
> T: Sandy, Umm...I think she will pretty much be able to hold her own too. Sheela, because she, you know is a very respectful, polite person, if anyone is going to be walked over by any other person or any other gender, I would say she would probably be in the most dangerous position to do so. Because you know, she would follow the role if any of them were to follow the role of a traditional female she might be the one. As far as career and academic choices I donít. But as far as social issues Iíd say if anyone falls in that trap it would be Sheela but you know - those would be in extreme circumstances. (Interview, 5/20/98)

Although Ms. Taylor was unable to fully understand Tanishaís behavior as it related to ethnic identity, she gives a more articulate analysis of the girls in terms of gender identities.

Ms. Taylor appears to have empathy with her students and designs her inquiry-based curriculum fully cognizant of how they may respond and what will be of interest to them. However, her personal interactions with the students are kept at a professional distance and interaction with the studentís parents usually occurred when studentís grades declined. Ms. Taylor maintains a structured classroom and on occasion sends students out of the classroom to an administrator for breaches of behavior and later follows up with parents. While she knows her students rather well

(her predictions for Sandy, Sheela, and Tanisha appear thus far to be accurate), they do not know her very well. She shares very little of herself with her students.

The dilemma for Ms Taylor is to maintain the academic achievement level of all her students through extra support to students whose grades are falling below her expectations of them. Follow up with parents and extra time after school are strategies she routinely uses to support those students. This dilemma arises because of her dedication to the ideal conveyed by the reform movement of science for all. She attempts to support the levels of achievement required for students to progress to the next level in high school fully aware of the realities of the range of abilities and interests of the students in her classroom. This dilemma raises the very real practical question of how to achieve the ideal expectation of "science for all" (Rutherford & Ahlgren 1990) that is conveyed by the reform vision (NRC, 1996). Ms. Taylor strives to attain that ideal.

Conclusions

Both of the teachers described in this study had great teaching strengths. Students from both their classrooms, who traditionally might not be expected to be successful in science, were considered by their teachers, their parents and themselves, to be successful in science.

The description of the teaching by these teachers to a large extent fit the description that teachers interviewed by Delpit (1995) described as good teaching (p. 118). They each made the material that they were teaching connect to student experiences and interests. Although the two teachers are different in their approach to teaching science, both are caring (Noblit, Rogers and McCadden, 1995) professionals who take every opportunity to provide their students with whatever they perceive they may need in order to be successful. Ms. Taylor has a clear focus on the science content material and appears to fulfill a role close to that described by the expectations envisioned in the NSES (NRC, 1996) and exemplifies a teaching model that promotes subject matter rich content. In contrast, Mrs. Dawson promotes an extremely personal style of teaching where science content is at times rather marginal. She develops a close relationship with her students and emphasizes the development of study skills and attitudes that will benefit them in later life.

Ms. Taylor, a European American, teacher, is quite insightful when it comes to gender relations. She is not as insightful about race relations. She canít figure out why Tanisha gets annoyed in class and where her difficulties arise. We suspect that part of this is due to the fact that she is female but white, and thus her personal experiences are more helpful for understanding gender relations than race relations. It may also be due to her training, which was more focused on issues of gender than race.

Mrs. Dawson, an African American, teacher, is personally knowledgeable of racism. When asked what challenges the GEIS Project participants might face suggested that the covert nature of racism is a serious threat. Her emphasis on building personal strength in order to withstand the difficulties they will face is likely due to her conviction that these skills are necessary to survive in a stratified society. She viewed sexism as inherent to society, an issue that the girls should be aware of and with the appropriate skills should be able to deal with.

It seems for Ms. Taylor, the ability to withstand obstacles is an attribute. An ability that you either have or do not have, not something that is taught. For Ms. Taylor, teaching science is her mission, not teaching students how to overcome the obstacles of sexism and racism. Ms. Taylor holds a strong stance in support of the NSES (NRC, 1996) vision of science for all. This has been criticized as failing to directly address issues surrounding equity of access to science through science education and that the document uses a "discourse of invisibility" (Rodriguez, 1997, p. 21). This lack of visibility is a detriment to teachers who do not have knowledge of what school is like for a poor girl or a girl of color.

Both teachers also worked hard to try and connect their teaching with the lives and interests of their students. The great strength of Ms. Taylor was that she accomplished this while also keeping science content central to her curriculum. At times, science content seemed marginal in Mrs. Dawsonís class. However, there were remarkable efforts by Mrs. Dawson to use her position as science teacher to do more than teach science. She also worked on building a community of adults and children who cared about one another and on helping students construct views of themselves as people who have the strength and skills to overcome adversity.

Implications for the Development of Culturally Relevant Science Teachers

We think that these descriptions of these two teachers can illustrate to others several important aspects of culturally relevant science teaching: 1. Making connections between science and students lives. 2. Assuring equal access to resources. 3. Making expectations explicit. 4. Establishing strong teacher-student relationships. 5. Creating a sense of community among students, parents, and teachers. 6. Making science a central concern of the community. There is no single template to illustrate how culturally relevant science teaching appears in the classroom. Each teacher, through their own life experiences will develop strengths in different areas, what is important is to be able to recognize the range and diversity of these strengths and how they might appear in the classroom.

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APPENDIX I

Structured Interview Protocol:

1) How do you define success in science?

How does "school" science relate to "everyday" science

What does it take to be successful at science?

What do you consider to have been your main teaching objectives for the girls?

How do school requirements / constraints affect lesson content? What might you choose to change if there were no constraints?

How do you describe your own success in science?

What strategies did you find contributed to your own success? How?

What would success for your students look like to you as their teacher?

2) What teaching strategies have you found to be most successful?

What structure do you provide to support the students?

What are your expectations from these students?

What are your opinions of group work versus individual work?

3) How would you describe your interactions with the girls in the study?

How well do you feel that you know the girls? Their families?

Do you think your own gender / race make a difference in how you interact with the girls? How?

When you consider the girls do you see any particular strengths or weaknesses?

What advice would you offer to these girls as they move forward in their careers?

What challenges do you think that they might face (as minorities/women)?